DOE/RL-2005-20
Revision 0

233-S Plutonium Concentration Facility Removal Action Closeout Report

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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H. Author/Requestor

D. L. Klages Dennis L. Klages 6/7/05
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Responsible Manager
R. C. Brunke R C Brunke 6/9/05
(Print and Sign)

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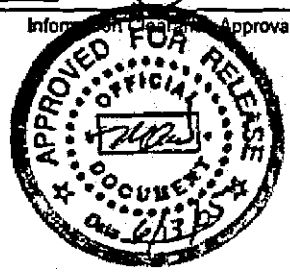

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TERMS

233-S Facility	233-S Plutonium Concentration Facility
ARARs	Applicable and/or Relevant and Appropriate Requirements
CA	contamination area
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
cm	centimeter
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ft	foot
in.	inch
LLW	low-level waste
m	meter
m^2	square meter
MBq	MegaBecquerel
NDA	nondestructive assay
PAPR	power air purifying respirator
PPE	personal protective equipment
PR	product receiver
REDOX	202-S Reduction and Oxidation Plant
sq ft	square foot
TRU	transuranic
WIDS	waste information data system
WIPP	Waste Isolation Pilot Plant

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233-S PLUTONIUM CONCENTRATION FACILITY REMOVAL ACTION CLOSEOUT REPORT

1.0 INTRODUCTION

Hanford's 233-S Plutonium Concentration Facility (233-S Facility) had been in a slow and continual state of deterioration since its deactivation in 1967. For nearly three decades, surveillance and maintenance was performed to ensure confinement of the building's significant levels of plutonium contamination. Severe winter conditions in 1996 accelerated the rate of building deterioration and heightened the potential of personnel exposure to contamination and environmental release. Based on the increase in risks and associated facility maintenance costs, decisions [under processes of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) *of 1980*] were subsequently made by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) to perform a response action.

The *Engineering Evaluation/Cost Analysis for the 233-S Facility* (DOE/RL-96-93) was developed and submitted to the public for comment. The document presented four alternative approaches for future facility management and the resultant levels of safety that could be anticipated. Decontamination and/or stabilization of the facility followed by demolition and disposal was selected as the most responsive approach to safety concerns and in concert with planned land remediation actions. This selection is documented in the March 1997 Action Memorandum (DOE-RL 1997) that provided direction to proceed with this non-time-critical removal action project. The memorandum also identified the Applicable and/or Relevant and Appropriate Requirements (ARARs) for the 233-S decontamination and demolition (D&D) activities.

The final end-state was changed from decontamination and demolition of the 233-S Facility down to 3 feet belowgrade, to a slab-on-grade for the 233-S Facility. The final end-state was agreed to by both DOE-RL and EPA and documented in a letter to the Administrative Record titled *233-S Pu Concentration Facility D & D Project Endstate*, signed on December 5, 2002 (EPA 2002).

There are two reasons the end-state was changed. The first reason was that leaving the slab intact lowers the risk to personnel from subsurface contamination in the interim period between completion of the 233-S demolition project and the disposition of the nearby 202-S Reduction and Oxidation Plant (REDOX) Facility. The slab provides shielding and prevents inadvertent intrusion into subsurface contamination by personnel. The second reason is the characterization of the subsurface contamination and slab should be addressed as part of an integrated remedial action for the REDOX area.

The purpose of the 233-S Facility Demolition Project was to safely demolish the 233-S Facility and to package and properly dispose of all associated waste material. Removal action objectives for the 233-S Facility project, to protect human health and the environment included the following:

- Reducing the threat of release of hazardous substances contained in the 233-S Facility
- Protecting workers from physical, chemical, and radiological hazards posed by the 233-S Facility
- Achieving project life cycle cost effectiveness by reducing or eliminating S&M costs by reducing or eliminating the potential for a release of hazardous substances to the environment

- Attaining applicable or relevant and appropriate requirements (ARARs) to the fullest extent practicable
- Minimizing waste disposal costs
- Facilitating and being consistent with future remediation for the 200 Area.

The scope of this project included the 233-S Plutonium Concentration Building (233-S Building), the 233-SA Exhaust Filter Building (233-SA Building), and the Mobile Office-317 (MO-317). A photo and schematic of the 233-S Facility are provided in Figures 1 and 2, respectively. Upon project completion, the concrete floor slabs for the 233-S and 233-SA Buildings remained in-place and were capped with concrete, then covered with clean fill, and posted as an underground radioactive material area. The slabs are being maintained by the surveillance and maintenance organization until the area is remediated. Surveillance and maintenance includes an annual inspection to check for animal intrusion and verify postings based on surveys.

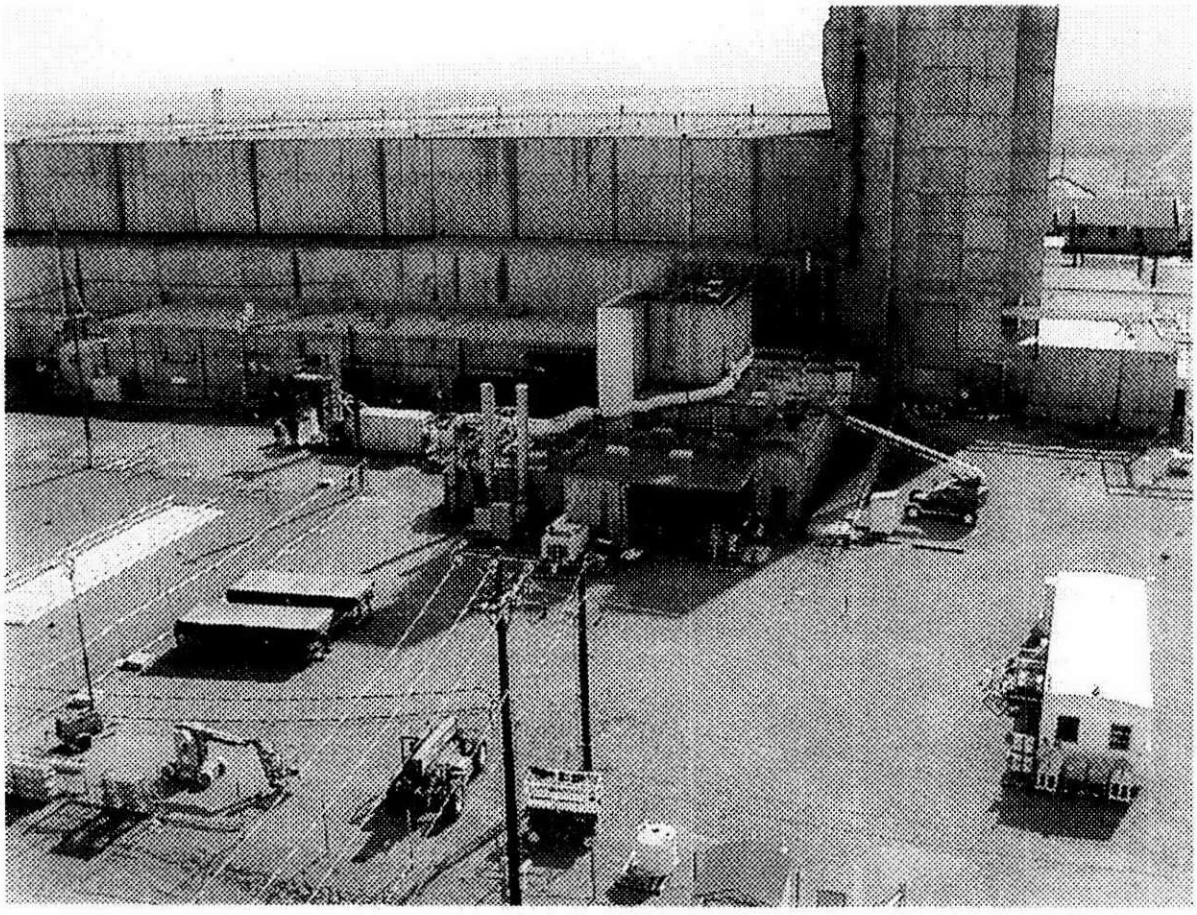

Figure 1. 233-S Facility (photo, looking south, taken before demolition began in October 2003). The 202-S REDOX facility is the large canyon building in background.

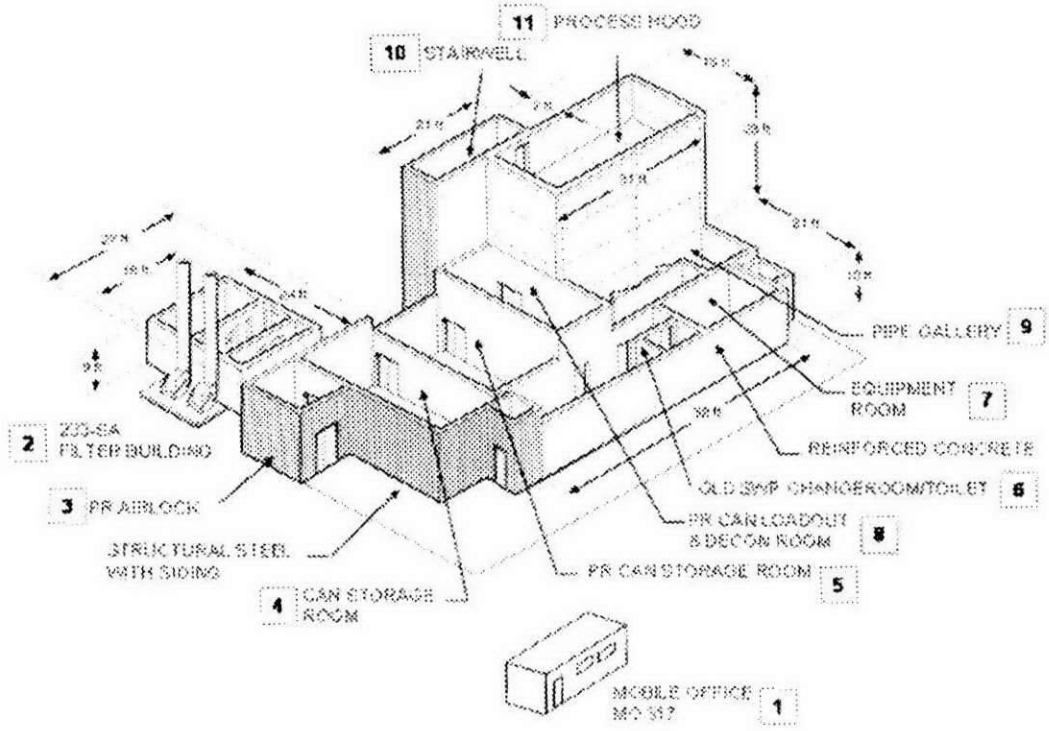

Figure 2. Schematic of the 233-S Facility (view looking to southeast; numbers in boxes indicate demolition sequence).

The bulk of the building's materials were designated as low-level waste (LLW) and disposed in Hanford's CERCLA landfill known as the Environmental Remediation Disposal Facility (ERDF). Less than one percent of the demolition debris was designated as transuranic (TRU) waste; this waste was packaged for temporary storage at Hanford's Central Waste Complex, and will eventually be shipped for ultimate storage/disposal at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico.

1.1 FACILITY DESCRIPTION

The 233-S Facility was located in the southwest quadrant of Hanford's 200 West Area. Original construction of the facility began in 1953 and was completed in 1955. Several modifications (expansions) were made to the original structure over the following decade, resulting in an overall footprint of approximately 325 square meters (m^2) [3,500 square feet (sq ft)].

The 233-S Facility was comprised of the 233-S Building and the 233-SA Building. The 233-S Building was a reinforced concrete structure, with a footprint of 11.3 m (37 ft) x 25.7 m (86 ft), and roof elevations ranging from 3.7 m (12 ft) to 9.7 m (32 ft). Concrete wall thicknesses ranged from 23 centimeters (cm) [8 inches (in.)] to 30 cm (12 in.). Several exterior portions of the building were made of structural steel framing enclosed with corrugated metal exterior siding. The four-story portion of the 233-S Building (i.e., the process hood) was the area of highest contamination. The 233-SA Building, located northeast

and just adjacent to the 233-S Building, was a single-story, reinforced-concrete structure with 15-cm (6-in.)-thick walls.

1.2 233-S FACILITY HISTORY

From 1956 to 1965, the 233-S Facility served a role in the process of developing weapons-grade plutonium. Hanford's plutonium production process began by irradiating uranium fuel at the Site's 100 Area production reactors. Spent reactor fuel was then transported to the REDOX where the aluminum cladding was stripped from the fuel elements and plutonium was extracted as a plutonium nitrate solution. This solution was piped from the neighboring REDOX Plant to the 233-S Facility for additional concentration and packaging. Concentration was performed in the 233-S Building's process cell by evaporation and/or ion-exchange treatment. The concentrated plutonium solutions were then packaged in stainless steel, criticality-safe, product receiver (PR) cans; the PR cans were placed into larger canisters for transport via roadway to Hanford's 231-Z Plutonium Isolation Building or the 234-5Z Plutonium Finishing Plant for further processing.

Several significant processing upsets took place during the 233-S Facility's active operations. In 1956, failure of an air-activated diaphragm valve resulted in the release of approximately 32 grams of plutonium solution to the floor of the 233-S Building's process hood, with subsequent spread of contamination to the REDOX Facility. In 1963, chemical reactions within an anion-exchange concentrator resulted in a rapid pressure increase and the release of plutonium-laden resin beads. This, in turn, ignited a fire that burned for 90 minutes, causing extensive damage to process equipment, damage to the ventilation system filter, a spread of gross alpha contamination within the process area, and distribution of radioactive contamination to other portions of the building's interior and the exterior roof surfaces. Between 1 to 3 kilograms of plutonium were lost as result of this fire. Following extensive cleanup, and construction of the 233-SA Exhaust Filter Building, the 233-S Facility resumed operations until 1967.

Between 1967 and 1987, limited efforts were made to perform initial characterization of the facility and remove selected equipment and material from the building's load-out area. After 1987, the facility sat idle for nearly another decade.

Again, as part of the CERCLA decision process, a report entitled *Engineering Evaluation/Cost Analysis for the 233-S Facility* (DOE/RL-96-93) presented four optional approaches for further facility management. For each option, the resulting levels of safety were projected. Decontamination and/or stabilization of the facility, followed by demolition and disposal, was selected as the approach most responsive to safety concerns and the most supportive of planned land remediation actions (DOE-RL 1997).

From 1997 to 2002, a significant amount of decommissioning scope including the removal of equipment from the process and non-process areas of the 233-S Building was completed. In addition to installing a portable exhauster, this scope included removing roof-mounted ventilation ducting, process area viewing room support structure, 14 process vessels, nearly 1,500 m (5,000 ft) of process piping, and other equipment from the equipment room, control room, and other areas of the facility.

2.0 DEMOLITION PREPARATIONS

In mid-2002, the project focused the following 12 months on final removal of equipment, limited decontamination, initial radiological characterization of the building's structural materials, application of

fixative coatings to "lock-down" the potentially dispersible contamination, deactivation of the portable ventilation exhauster system, and removal of temporary power and lighting services.

During the summer of 2003, requests-for-interest were issued and proposals to provide technical support and a limited amount of equipment for the demolition of the 233-S Facility. A contract was subsequently issued for consulting services. Specialized heavy equipment was hired, supported by subcontracted engineering services, and concrete-sawing expertise.

The following subsections describe the preparatory efforts prior to the start of demolition in October 2003.

2.1 RADIOLOGICAL CHARACTERIZATION

Extensive radiological surveys and nondestructive assay (NDA) measurements were performed during the various stages of equipment and material removal from the 233-S Facility in 2002 and early 2003. A final sampling plan was developed and implemented in mid-2003 to support (1) waste disposal planning for the purposes of minimizing the volume of TRU waste, and (2) evaluation of specific demolition techniques to minimize the release of radiological material during the demolition process. As noted in Table 1, the total mass of TRU isotopes within the 233-S Building had been estimated at 13.4 grams (Mantooth et al. 2003), with the majority of contamination located on the west and north walls of the 233-S process hood. This mass relates to contamination levels in the process areas in excess of 33.4 MegaBecquerels (MBq)/m^2 ($20x10^6$ disintegrations/min/100 cm^2 or 9,000 nanocuries/100 cm^2). The isotopic distribution of TRU within the 233-S Building is summarized in Table 2.

Table 1. TRU Mass Estimates for 233-S Locations.

Location	TRU (grams)
Can Storage Room	0.061
SWP Change Room	0.054
Pipe Gallery	0.141
PR Can Storage Room	0.039
PR Can Loadout	0.081
Stairwell – 1st Floor Wall	0.024
Stairwell – 2nd Floor Wall	0.055
Stairwell – 3rd Floor Wall	0.026
Stairwell – 4th Floor Wall	0.018
Stairwell – 1st Floor Landing	0.023
Stairwell – 1st Floor Landing	0.049
Stairwell – 1st Floor Landing	0.037
Stairwell – 1st Floor Landing	0.016
Stairwell – Ceiling	0.002
Process Hood – West Wall	5.682
Process Hood – North Wall	6.175
Process Hood – South Wall	0.038
Process Hood – East Wall	0.828
Process Hood – Ceiling	0.037
Total	13.39

Table 2. Isotopic Weight Distribution as Determined through Sampling and Analysis Data (w_i = weight of isoptope; w_T = total weight of measured isotopes; w_{TRU} = weight of transuranic isotopes).

Isotope	Weight Fraction (w_i/w_T)
Plutonium-238	0.0007
Plutonium-239	0.8405
Plutonium-240	0.1046
Plutonium-241	0.0074
Plutonium-242	0.0059
Americium-241	0.0108
Neptunium-237	0.0301
	w_{TRU}/w_T=0.9926*

* w_{TRU} includes all isotopes listed above, except for plutonium-241 since it is not a TRU isotope.

2.2 RADIOLOGICAL ANALYSIS OF DEMOLITION TECHNIQUES

Characterization data (as referenced above) were utilized for purposes of waste designation, and for performing radiological analysis of demolition techniques. The Hotspot 2.01 (Hotspot 2002) atmospheric dispersion computer code was utilized to estimate the downwind personnel-committed-dose and surface contamination levels that would result from four different demolition techniques (Knight and Mantooth 2003). These techniques included demolition via the use of (1) a wrecking ball, (2) mechanical shear, (3) circular diamond-blade wall sawing, and (4) continuous diamond-wire sawing. Historical averages for Hanford Site wind speed and stability class were used for the model. The wrecking ball method demonstrated the greatest potential for generating airborne contamination, followed in order by mechanical shearing, circular diamond- blade wall sawing, and continuous diamond-wire sawing.

As reflected in Table 3, for a given quantity of radioactive material at risk, use of the circular diamond-blade or wire saws would result in a level of downwind contamination two-to-three orders of magnitude less than the more aggressive techniques. Values for use of a wrecking ball are not noted below, as that method was not considered for further evaluation because the method was not approved for use under the facility's safety basis.

Table 3. Evaluation of Demolition Methods.

Demolition Method	Maximum CEDE* (rem)	Maximum Alpha Contamination (d/min/100cm2)	Distance to Max. (km)
Mechanical Shearing	2.1	1.8E+05	<0.01
Circular Diamond-Blade Wall Sawing	0.56	460	<0.01
Continuous Diamond-Wire Sawing	0.046	500	<0.01

*CEDE = Committed effective dose equivalent

The values noted in Table 3 compare unmitigated releases resulting from each demolition method. Mitigation techniques such as pre-decontamination, water misting/fogging, fixative applications, or other engineered methods would further reduce the potential for release of radioactive material.

2.3 DEMOLITION METHOD SELECTION

Initial concepts for removing the 233-S Facility involved decontamination of the facility's interior surfaces, followed by the use of conventional demolition techniques (e.g., use of a concrete shear to demolish and size-reduce all building structures and material). In November 2002, a company was subcontracted to provide decontamination services using an ultra-high-pressure (i.e., 30,000 pounds per square inch) hydrolaser washing system that included a shrouded applicator and vacuum recovery system. The use of this decontamination technique was terminated in January 2003 after experiencing difficulties related to protrusions from the wall and other irregular surfaces and the ability to reliably accommodate the many types and layers of fixative materials that pre-existed on the building wall surfaces. The decision was made that a more conservative and controlled demolition approach was necessary to safely protect the D&D workers, employees at neighboring facilities, and the environment.

Based on an April 2003 value-engineering session (Parker 2003) involving input from all levels of 233-S Facility staff, a proposed demolition plan, and other planning efforts, an acceptable demolition approach was developed for the 233-S Facility. The selected approach involved using an excavator equipped with a concrete-shear attachment to size-reduce the single-story and less-contaminated portions of the 233-S and 233-SA Buildings. The selected approach also involved use of circular diamond-blade wall saws for cutting the taller and more contaminated portions of the 233-S Facility (i.e., process hood) into large, rectangular blocks that were then lowered to ground level via crane.

After the combined shearing and sawing approach was selected for 233-S Facility demolition, a decision was made to perform additional and more detailed atmospheric dispersion modeling to confirm that the work could be performed without releasing alpha contamination beyond the contamination area (CA) boundary in excess of 33.4 Bq/m^2 (20 d/min/100 cm^2). The dispersion modeling was performed using ISC-PRIME (an EPA-developed program that uses actual weather conditions). The ISC-PRIME code was considered more applicable for modeling potential atmospheric releases from 233-S than the previously used HotSpot 2.01 code, for the following reasons: (1) it uses actual site weather conditions reported hourly; (2) it has algorithms that account for the building "downwash" generated by the 202-S REDOX Plant; and (3) releases to the atmosphere from demolition activities could be matched to time of release and actual weather conditions, providing a more accurate picture of where potential contamination would occur.

The ISC-PRIME dispersion modeling results indicated that all areas with contamination levels exceeding 33.4 Bq/m^2 (20 d/m/100 cm^2) would lie within a 40 meter-radius CA boundary as measured from the center of the 233-S process hood. These analyses helped to reaffirm that this first-of-its-kind open-air demolition project should proceed as planned.

3.0 DEMOLITION OPERATIONS

Demolition operations at the 233-S Facility began in mid-October 2003. The mobile office MO-317, the 233-SA Building and the single-story portions of the 233-S Building were safely demolished via shearing methods, packaged, and buried in the ERDF landfill. This scope was accomplished by late December 2003. Between the months of January 2004 and April 2004, the highly contaminated 233-S process hood was dismantled via block cutting and removal techniques, and all associated waste was

packaged and either buried in the ERDF landfill or placed in temporary storage at Hanford's Central Waste Complex for eventual disposal at WIPP. All demolition scope was accomplished without any release of contamination outside of the controlled area.

The following subsections describe a number of the controls established to accomplish this work and the general approach employed.

3.1 RADIOLOGICAL CONTROLS/ENGINEERING

A variety of radiological controls were established to protect the D&D workers, and to prevent the spread of contamination outside of the CA (Mantooth 2003). As noted earlier, the CA boundary was established at a 40-meter (131-ft) radius from the center of the 233-S process hood. A radiological buffer area was also established 10 meters (30.5 ft) beyond the CA boundary to allow for staging of supervisory personnel, waste containers, and a variety of support equipment.

Fugitive dust emissions from the breaking and/or packaging of concrete rubble were controlled by use of water-efficient misters and foggers (i.e., MARTIN® FOG CANNONs™) that were positioned on two sides of the demolition activity to provide light and general-area misting; each unit delivered approximately 53 liters/min (14 gal/min). A low-flow, 9.5 liters/min (2.5 gal/min) misting system head was designed and installed directly into the excavator arm, with nozzles positioned at the throat of the shear. The design, which localized a concentrated mist directly into the cutting action of the shears, proved to be extremely effective. Dust suppressants (e.g., Soil-Sement® solutions) were also applied prior to shut-down periods and prior to any anticipated high-wind conditions.

Engineered controls were established for capturing the potentially-contaminated water that was generated while cooling/lubricating the circular diamond-saw blades as they dissected the highly contaminated process hood into large blocks. Prior to the start of shear demolition operations, the predetermined saw-cut pattern lines were marked on the interior wall and ceiling surfaces of the process hood. A network of metal gutters was then installed via powder-actuated fasteners to cover each of the saw cut lines on the inner wall and ceiling surfaces; the gutters were positioned to drain to a common manifold for water collection and disposal. To address the need to capture the potentially contaminated saw cooling/lubrication waters on the exterior of the process hood, a uniquely designed shroud that attached directly to the saw as it cut along the concrete surfaces was developed. A set of saw receiver shrouds were also created for attaching directly to the ends of the saw track to capture concrete slurry as the saw blade traveled beyond the corners, openings, or ends of the structure as it completed the saw cuts.

Wind conditions were continually monitored via windsocks, a nearby weather station, and hand-held anemometers. All workers and support equipment were required to be located upwind of the demolition activity and at a distance sufficient to prevent inadvertent contamination should the wind direction change. The maximum allowable wind speed for demolition operations was 12 miles per hour.

Personal protective equipment (PPE) requirements for all demolition and support personnel within the CA included a single set of radiological PPE clothing, waterproof rain gear, and a power air purifying respirator (PAPR) with hood. A Hanford standard dosimeter and a lapel air sampling pump were also required for radiation monitoring of personnel. Contamination surveys and air monitoring were routinely

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performed via three grab-air samplers, five continuous air monitors, 18 fixed-plate survey stations, and CA exit surveys of personnel and equipment.

3.2 PHASE 1 DEMOLITION - SHEARING OPERATIONS

During the period of late October 2003 to mid December 2003, the MO-317, the 233-SA Building, the single-story portion of the 233-S Building, and the four-story stairwell (connected to the 233-S process hood) had been completely and safely demolished via shearing.

The shearing operations were accomplished using a 45,000 kg (100,000 lb) CAT® hydraulic excavator equipped with a 1,300 ton rotating mechanical shear. The demolition sequence began with the MO-317, as previously noted in Figure 2. Demolition and waste packaging/disposal of this relatively benign structure demonstrated that all equipment, personnel, dust suppression systems, and waste-loading procedures were indeed prepared and ready to proceed immediately to the more contaminated 233-SA Building.

Since nearly all of the structures demolished during the shearing phase of the project (with exception of the four-story stairwell) were less than 3.6 m (12 ft) from grade level, all building material removed by the excavator were generally directed onto the interior slab surface. Protection of adjacent building and structures (e.g., an electrical transformer on the east side of 233-S, and an underground pipe trench located on the west side of 233-S) from falling rubble was established via nylon netting barriers and other materials prior to the start of demolition.

After the 233-SA Building was demolished and its waste was loaded, demolition of the 233-S Building proceeded from northeast to southwest. Photographs in Figure 3 depict the field settings during demolition of the 233-SA Building and weeks later when the excavator was demolishing the four-story stairwell on the east side of the 233-S process hood.

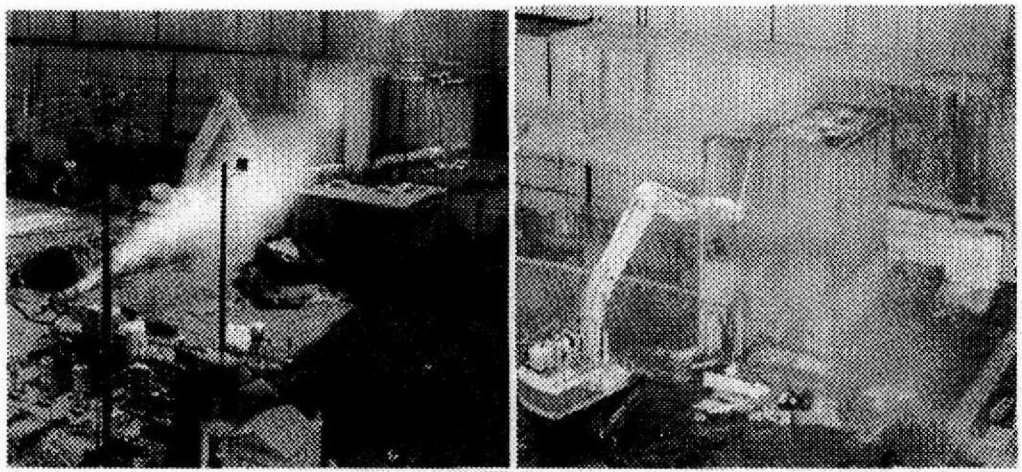

Figure 3. Images During Demolition – left photo depicts demolition of the 233-SA Building (note the FOG CANNON™ in lower left of the image and the ERDF waste container in center); right photo depicts subsequent demolition of the 233-S process hood stairwell.

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Loading of concrete into the lined ERDF waste containers, each 2.4-m wide x 6.1-m long x 1.8-m high (8 ft wide x 20 ft long x 6 ft high), was performed whenever a sufficient quantity of rubble was generated. The rubble piles were kept wet at all times. The concrete rubble was loaded into the ERDF containers using a front-end loader. The structural steel and metal siding associated with the process hood stairwell were primarily loaded into the ERDF containers via the grappling capability of the shear jaw. A total of 65 ERDF containers was used to package and dispose of all debris generated during demolition of MO-317, the 233-SA Building, the lower portions of the 233-S Building, and the stairwell attached to the 233-S process hood.

3.3 PHASE 2 DEMOLITION – SAWING OPERATIONS

Removal of the highly-contaminated 233-S Building process hood began in January 2004 and was completed in April 2004. This task was accomplished by segmenting the process hood structure into pre-engineered panels using track-mounted, diamond-blade wall saws. Photos of initial and intermediate states of saw cutting are shown in Figure 4. After each rectangular panel was cut, it was lowered via crane, and then prepared for disposal. Most panels were wrapped in plastic and polypropylene bags and transported for disposal as LLW at the ERDF site. Designated panels from the lower northwest portion of the process hood were classified as TRU waste, and were packaged and transported to Hanford's Central Waste Complex. The TRU waste will eventually be disposed at the WIPP Site in Carlsbad, New Mexico.

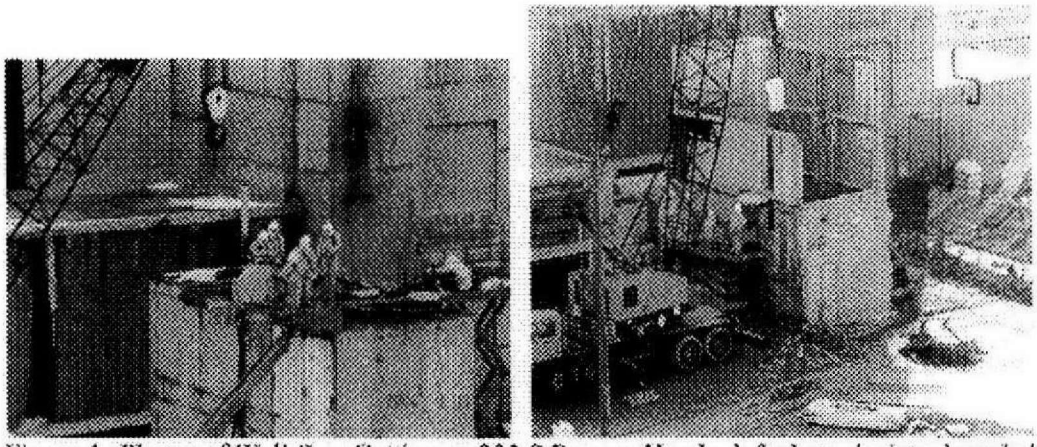

Figure 4. Photos of Wall-Saw Cutting on 233-S Process Hood – left photo depicts shrouded concrete wall saw at the beginning of a horizontal roof cut; right photo depicts the saw being set up after 11 blocks had been cut and removed.

A detailed cutting plan was prepared to ensure that integrity of the roof and wall structures was maintained during the segmentation and crane/rigging evolutions. The reinforced concrete wall and roof sections were 30.5 cm (12-in.) thick; the largest of panels were cut to 2.4 m x 4.6 m (8 ft x 15 ft), weighing approximately 9 metric tons (20,000 lb). Over 80 cuts were necessary to fully segment and remove the process hood structure. The total length of cutting was in excess of 275 m (900 ft).

Before demolition operations began in October 2003, a core-boring drill was used to create a number of through-holes in predetermined location to install lifting hardware. These holes were installed in the roof and on all accessible/exposed locations on the walls of the process hood. After the stairwell and single-story portions of 233-S Building were demolished, the remaining holes were installed. As

discussed earlier, some of the additional preparations for saw cutting included the installation of gutters on the interior walls of the process hood to capture the cooling/lubrications waters that sprayed-off from the rotating saw blades during the final break-through cuts.

3.4 POST DEMOLITION TASKS

During the months of May through June 2004, a wide variety of tasks were performed to support project closeout. Initial efforts were focused on decontamination of the demolition support equipment so that it could be removed from the 233-S project site and reused on future D&D projects at Hanford. Temporary utilities, support trailers, and storage containers were removed from the site. Miscellaneous waste was packaged and shipped for disposal. Radiological surveys of the demolition site were performed, and a clean layer of gravel was placed over areas surrounding the 233-S Facility's floor slabs. The floor slabs were also covered with clean gravel, a thin [approximately 100 cm (four inches)] concrete cap, and additional gravel on top of the concrete cap.

Prior to capping and placing gravel, radiological surveys were performed using standard survey equipment with measurements at the nodes of a predefined grid overlaying the contamination area. The grid dimensions were established in accordance with the guidance found in HNF-13536, Section 3.1.2, *Evaluation of Outdoor Contamination Areas*, which is based on the contamination potential, i.e., high or low probability areas.

The **high probability** area was assumed to be comprised of the 233-S and 233-SA slabs, plus sufficient space (at least 1 meter) on each side to encompass areas of highest contamination. A 1 meter by 1 meter sampling grid was established in the high probability area.

The **low probability area** was comprised of the area outside the high probability area but inside the CA Boundary. A 2 meter by 2 meter sampling grid was established in the low probability area.

The results of the post-demolition radiological survey are summarized in Figure 5.

The demolition zone was then posted as an underground radioactive material area. Project files were submitted for records retention purposes, and the facility's engineering drawings were updated and/or reclassified as "Inactive" within the Hanford Document Control System. Figure 6 depicts the project site before and after demolition.

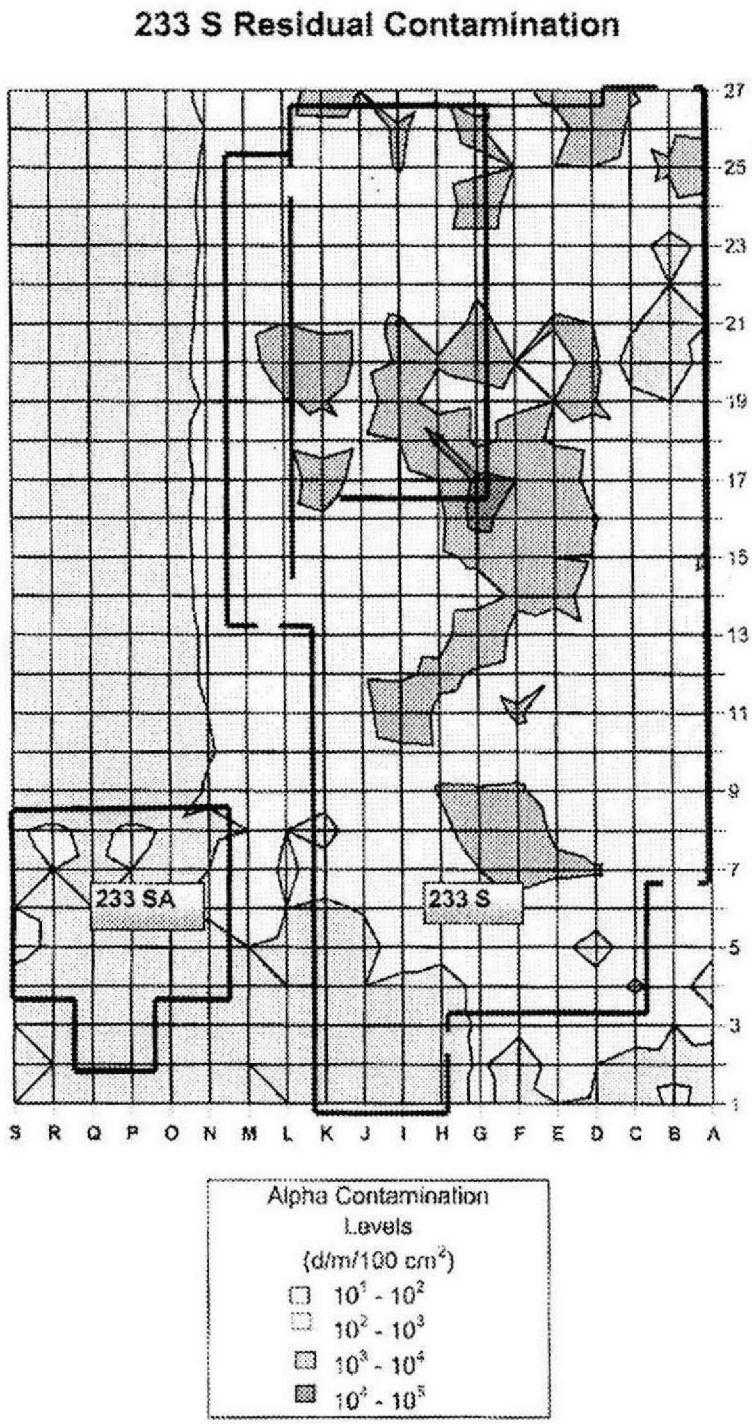

Figure 5. 233-S Residual Contamination Prior to Capping and Gravel Additions.

Figure 6. Photos of 233-S Facility Area Before and After Demolition: left photo dated October 2003; right photo dated June 2004.

4.0 SUMMARY AND CONCLUSIONS

This project represented the first open-air demolition of a highly-contaminated plutonium facility at the Hanford Site. This project may also represent the first plutonium facility in the DOE complex to have been demolished without first decontaminating surfaces to near "free release" standards. The decision to perform or not perform extensive decontamination of wall, floor, and ceiling surfaces prior to demolition of radioactively contaminated facilities presents significant trade-offs in cost, schedule, and risk.

Additional environmental air samplers were placed outside the 233-S Facility boundary, with samples collected throughout the demolition activities. There were no elevated analytical results from the demolition activities, though increases were seen due to "precipitation scavenging" - wherein radioactive fall-out contaminants inherent in the upper atmosphere are assimilated and brought down with the precipitation, ultimately influencing the contaminant levels measured in the ambient air. This same increase was seen throughout the Hanford Site during these time periods.

Following the removal action objectives, the 233-S Facility has been successfully removed, reducing the threat of release of hazardous substances that were contained within the facility, while minimizing waste disposal costs and following the applicable or relevant and appropriate requirements to the fullest extent practicable, without significant releases to the environment and without recordable personnel injuries.

The remaining 233-S Facility foundation and subsurface contaminated soil will now be included in an integrated future remedial action for the REDOX area. The Hanford waste information data system (WIDS) has also been updated to reflect the new description of the 233-S Facility.

5.0 REFERENCES

DOE/RL-96-93, 1997, *Engineering Evaluation/Cost Analysis for the 233-S Plutonium Concentration Facility*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1997, "Action Memorandum for the 233-S Plutonium Concentration Facility," letter from L.K. Bauer to J. D. Wagoner, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 2002, *233-S Pu Concentration Facility D&D Project Endstate*, letter dated December 5, 2002 to Administrative Record, from C. Cameron, U.S. Environmental Protection Agency, Region 10, and H. Bell, DOE, U.S. Department of Energy, Richland, Washington.

HNF-13536, 2003, *PIIMC Radiological Control Procedures*, "Evaluation of Outdoor Contamination Areas", Fluor Hanford, Richland, Washington.

Hotspot, 2002, Documentation and software available at: www.llnl.gov/nai/technologies/hotspot

W. J. Knight and D. S. Mantooth, 2003, *233-S Plutonium Concentration Facility Decommissioning Project – Radiological Analysis of Demolition Techniques*, CP-16804, Rev. 0, Fluor Hanford, Richland, Washington.

D. S. Mantooth, C. P. Barton, and D. L. Moder, 2003, *Radiological Characterization Report for the 233-S Plutonium Concentration Facility*, CP-17662, Rev. 0, Fluor Hanford, Richland, Washington.

D. S. Mantooth, 2003, *Radiological Safety Plan for the 233-S Facility Demolition Project*, HNF-17273, Rev. 2, Fluor Hanford, Richland, Washington.

Parker, 2003, *Technical Report, Planning Session Report on 233-S Demolition*, Los Alamos Technical Associates, Inc.